

# Solving and Creating Cluster Problems

### Materials

- Interlocking cubes (50–60 per student)
- Student Sheets 4–6 (1 per student)
- Student Sheet 7 (1 per student, homework)
- Stick-on notes (3–5 per student)
- Overhead projector (optional)
- Paper and pencils
- Student Sheet 8 (1 per student, homework)

### What Happens

Students discuss strategies for making close estimates for multiplication problems. They solve a double-digit multiplication problem in two different ways. Students then spend time solving cluster problems and writing cluster problems for two-digit by two-digit multiplication problems. They continue to work on difficult multiplication combinations and finish their Multiple Towers. Their work focuses on:

- using familiar landmark numbers to make estimates
- partitioning numbers into smaller, more familiar numbers
- solving double-digit multiplication problems

### Activity

#### Making Close Estimates

Put the following problem on the board or overhead:

$$56 \times 4 =$$

Many times when we have to solve problems, we can make a close estimate as a way of beginning. For example, what are some estimates for this problem? Would the answer be more than 100? More than 200? More than 300? What helps you make an estimate?

Have a few students share their estimates. Then put another problem on the board or overhead:

$$28 \times 15 =$$

Here's another problem I'd like you to make an estimate for. What are some of your ideas?

If students are having problems making estimates, you might offer them landmark numbers to think about as you did in the previous problem. Questions like "Is it more than 100? More than 500?" often help students narrow in on what the possibilities might be as well as give them a strategy for estimating using landmark numbers.

As students share their strategies for estimating, highlight those strategies where the student may have multiplied by 10—such as "I know that 28 times 10 is 280, then there are five more 25's, so that's around 400," or "Well, 20 times 10 is 200, so it's at least 200."

## Activity

Distribute Student Sheet 4,  $32 \times 21$ , to students. Tell students that you would like to see how they are thinking about multiplication problems and the strategies they might use to solve them.

Explain they should solve this problem in two different ways. Remind them that in addition to finding the answer, they should communicate how they solved the problem by using equations or words.

This task is one way of assessing students' understanding of multiplication, in general, and the kinds of connections they are making among related multiplication problems. Though they have not had direct experience with two-digit by two-digit multiplication problems, they have had lots of experiences with multiplication, looking for patterns, and thinking about the structure of numbers and how they can be broken apart into manageable components. In the following sessions, students will have more opportunities to discuss and work with cluster problems involving this type of problem.

As you observe students working and as you look through this set of Student Sheets, there are a couple of questions you can focus on:

- What types of strategies did students use to solve the problem? (repeated addition, setting up a cluster, breaking the problem into smaller problems)
- Are students demonstrating an understanding of partitioning large numbers into more familiar parts as a way of multiplying?

♦ **Tip for the Linguistically Diverse Classroom** Have students with limited English proficiency do this assessment orally. Ask them to demonstrate how they would solve this problem by using two methods. Observe what kinds of materials they use and what kind of notation they record.

## Teacher Checkpoint

### Solving a Problem in Two Ways

## Activity

When students have finished Student Sheet 4, collect their papers. Put  $32 \times 21$  on the board or overhead.

If we wanted to make a cluster of problems to go along with this problem, what are some multiplication problems related to this one that might help you solve this problem? You might want to think about the strategies for solving cluster problems we discussed in our last math class.

Make a list of the problems students suggest. Encourage students to explain how their problems are related to  $32 \times 21$ .

### Making a Cluster of Problems

Working from the list of related problems, students work in pairs to collect a cluster of four problems they feel would help them solve  $32 \times 21$ . Students then solve their cluster problems.

Students record their cluster problems in large writing on sheets of paper and post them around the classroom. Set aside five to ten minutes for students to walk around and look at each other's sets of cluster problems. As students circulate around the room, encourage them to look at each cluster and see if they can understand why the authors chose that particular set of problems. They can post stick-on notes with their initials on problems they do not understand.

If you have time, have a brief discussion so students can share observations or ask questions about cluster problems they did not understand.

**Doing and Writing Cluster Problems** For the remainder of Sessions 2 and 3, students work on solving sets of multiplication cluster problems on Student Sheet 5, Cluster Problems (pages 1 and 2), and writing cluster problems to go with two-digit multiplication problems on Student Sheet 6, Making Cluster Problems (pages 1 and 2). On Student Sheet 5, point out that students should first make an estimate of the last problem in the cluster before solving each problem in the cluster. Encourage them to think about landmark numbers; estimates such as “between 500 and 600” are appropriate responses.

Students can work alone or with partners. After each student makes up a set of cluster problems using Student Sheet 6, he or she can exchange the clusters with another student and solve each other's cluster problems. After they have solved them, they should exchange back and go over each other's work.

Make it clear to students that the cluster might not contain all the problems they need to solve the last problem in the group. They may need to add some problems of their own to the cluster.

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❖ **Tip for the Linguistically Diverse Classroom** For Student Sheets 5 and 6, have students with limited English proficiency continue to “write” about how they solved the cluster problems by using just numbers and symbols in parenthesis, such as a heart ♥ for problems they know “by heart.”

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While students are working on these cluster problems, circulate around the room and observe them working. You might also want to work with a small group of students who are having difficulty solving cluster problems.

**Note:** If you feel the multiplication problems are too difficult or you feel that some students are ready for harder problems, adjust the numbers according to the needs of your students.

For those students who finish early, suggest they either work on their list of difficult multiplication pairs or build a Multiple Tower for a number that has not been explored yet.

## Sessions 2 and 3 Follow-Up

**More Cluster Problems** After Session 2, assign students two sets of cluster problems (Student Sheet 7, Cluster Problems) to solve and write about. Have students exchange their cluster problem solutions with a partner during Session 3.

**Other People's Strategies** After Session 3, ask students to interview adults to find out what strategies they use to multiply mentally. With the assistance of the adult, they write down the strategy on Student Sheet 8, Other People's Strategies, so they can explain it to someone else. You might collect the strategies adults have for doing one or two problems and display them on a class poster.



## Cluster Problems

Make an estimate for the last problem in each cluster.  
Then solve the problems in the clusters.

$$3 \times 25$$

$$10 \times 25$$

$$20 \times 25$$

$$23 \times 25$$

Estimate for  $23 \times 25$  \_\_\_\_\_

$$9 \times 30$$

$$10 \times 32$$

$$20 \times 32$$

$$19 \times 32$$

Estimate for  $19 \times 32$  \_\_\_\_\_

## **Other People's Strategies**

Ask at least two family members, older siblings, or neighbors to solve one or more of the following problems mentally.

$$23 \times 9 \quad 5 \times 32 \quad 21 \times 14$$

With the help of each adult, record the strategy he or she used so that you can explain it to someone else. Remember to take this sheet back to class.

The problem we worked on is \_\_\_\_\_.

This was the strategy we used to solve this problem:

The problem we worked on is \_\_\_\_\_.

This was the strategy we used to solve this problem.